33. ~~34~~. (Amended Once) An optical switch, comprising:

At least two waveguide holding members disposed on a substrate;

at least two holding member depressions disposed in each of said at least two waveguide holding members; and

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at least two substrate depressions disposed in said substrate,

wherein at least three of said substrate and holding member depressions are grooves, and wherein at least one of said substrate and holding member depressions is configured to permit transverse movement of said waveguide holding members relative to one another to effect optical switching.

REMARKS

Claims 1-3 and 5-34 are pending in the application. The Examiner has rejected claims 1, 2, 6, and 34. The Examiner has allowed claims 18-26 and 28-33. The Examiner has objected to claims 3-5 and 7-17 as being dependent upon a rejected base claim, and has indicated that claims 3-5 and 7-17 would be allowable if rewritten in independent form to include the features of the base claim and any intervening claims. The Examiner has indicated that claims 6 and 34 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, second paragraph.

Assignee has amended the specification, formal drawings, and claims to correct various minor clerical errors in the specification, formal drawings, and claims. No new matter has been added.

Regarding the clerical errors in the claims, claim 10 has been amended to replace the term "groove" with the term "pit", and vice versa, because as originally written claim 10 claimed the same subject matter as claim 9.

Claims 14 and 15 have been amended to depend from claim 12 rather than claim 11, in order to provide a clearer antecedent basis for the "pit" and the "groove." In addition, claim 15 has been amended to replace the term "groove" with the term "pit", and vice versa, because as originally written claim 15 claimed the same subject matter as claim 14.

Claim 30 has been amended to replace the term "longitudinal groove" with the term "transverse groove", to comport with the recitation in claim 28 (from which claim 30 directly depends) of "a first waveguide holding member having at least one transverse groove..." As originally written, claim 30 recited: "...said at least one longitudinal groove in said first

waveguide holding member." However, claim 28 does not recite a longitudinal groove, but rather a transverse groove, associated with the first waveguide holding member.

Regarding the clerical errors in the specification, the two consecutive paragraphs beginning at page 8, line 8 were amended to replace the term "transverse grooves 204" with "transverse grooves 202" to recite the correct reference numeral, "202", for the transverse grooves. Since the reference numeral for the transverse grooves is correctly recited to be "202" at page 8, line 17, no new matter is added. In addition, the two consecutive paragraphs beginning at page 8, line 8 were amended to replace the term "positioning members 205" with "positioning members 204" to recite the correct reference numeral, "204", for the positioning members. Since the reference numeral for the positioning members is correctly recited to be "204" at page 10, line 16, no new matter is added. Also, at page 8, line 8 the specification is corrected to replace the phrase "a perspective view" with "an exploded view" to comport with the contents of Fig. 2 and the description of Fig. 2 at page 4, line 9.

The paragraph beginning at page 9, line 3 was amended to replace the term "waveguides 210" with "waveguides 211" to comport with Fig. 2, which shows that the waveguides 211, not the waveguides 210, are disposed in the second waveguide holding member 206. Accordingly, no new matter is added.

The paragraph beginning at page 16, line 14, was amended at page 16, line 22 to recite that after the gap spacing is adjusted a suitable adhesive may be used to fix the position of the "second waveguide holding member 706", and not the "first waveguide holding member". New matter is not added, because it is clearly recited at page 16, line 17 that the "longitudinal motion of the second waveguide holding member 706 enables accurate gap spacing between the first waveguide holding member 703 and the second waveguide holding member 706..." Therefore, it is clearly a clerical error to have indicated that the first waveguide holding member is fixed in position with a suitable adhesive after the gap spacing is adjusted, and the correction does not introduce new matter. Various other clerical errors are corrected throughout the specification, as indicated above and in the attachment, but are not described in the remarks, as such corrected errors are self-explanatory.

OBJECTIONS

The Examiner has objected to claim 34, because in line 3 "wavguide" is misspelled. Assignee has amended claim 34 to recite the correct spelling of "waveguide." The Examiner has objected to claim 27 on the belief that the last line of claim 27 should recite "from at least" rather than "to at least". Assignee has amended claim 27 in the manner suggested by the Examiner to recite that the "...transverse movement selectively decouples at least one waveguide of said first waveguide holding member from at least one waveguide of said second waveguide holding member." Accordingly, Assignee believes that the objections to claims 27 and 34 are overcome, and, therefore, respectfully requests that the Examiner withdraw such objections.

REJECTIONS UNDER 35 U.S.C. 112

The Examiner rejected claims 6 and 34 under 35 U.S.C. 112, second paragraph, as being indefinite. Respecting claim 6, the Examiner stated that there was an insufficient antecedent basis for the feature "said transverse movement". Assignee has amended claim 6 to depend from claim 1 to provide a clearer antecedent basis for the feature "said transverse movement". Regarding claim 34, the Examiner stated that the last phrase of claim 34 was confusing. The Examiner raised questions regarding the phrase "no two opposing depressions". Assignee has amended claim 34 to delete the recitation of "no two opposing depressions." The Examiner also questioned whether the "at least three grooves" are on the substrate or the entire switch. Assignee has amended claim 34 to recite that "at least three of said substrate and holding member depressions are grooves", indicating that the three grooves may be on the substrate and/or the holding members. Accordingly, Assignee believes that the rejections of claims 6 and 34 under 35 U.S.C. 112 are overcome, and, therefore, respectfully requests that the Examiner withdraw such rejections of claims 6 and 34.

REJECTIONS UNDER 35 U.S.C. 102(b)

The Examiner has rejected claims 1 and 2 under 35 U.S.C. 102(b) as being anticipated by Kaplow. Assignee has amended claim 1 to include the subject matter recited in claim 4, which depended directly from claim 1. In particular, Assignee has added the feature that "said first waveguide holding member moves transversely relative to said second waveguide holding member." Since the Examiner has indicated that claim 4 would be allowable if rewritten in

independent form to include all the features of claim 1, claim 1, as amended, is allowable for at least this reason. In addition, since claim 2 depends directly from claim 1, which is now deemed to be allowable, claim 2 is believed to be allowable as well. Accordingly, the Assignee believes that the rejections of claims 1 and 2 under 35 U.S.C. 102 are overcome, and therefore, respectfully requests that the Examiner withdraw the rejections of claims 1 and 2.

ALLOWABLE SUBJECT MATTER

The Examiner objected to claims 3-5, and 7-17 as being dependent upon a rejected base claim (claim 1), and indicated that claims 3-5, and 7-17 would be allowable if rewritten in independent form to include the features of the base claim and any intervening claims. However, since claim 1 is now deemed to be allowable for the reasons given above, Assignee believes that the objections to claims 3, 5, and 7-17 are overcome, and, hence, claims 3, 5, and 7-17 need not be rewritten in independent form. Therefore, Assignee respectfully requests that the Examiner withdraw the objections to claims 3, 5, and 7-17. Assignee has canceled claim 4, rendering the objection of claim 4 moot.

In view of the foregoing amendments and remarks, it is believed that the claims in this application are now in condition for allowance. Early and favorable reconsideration is respectfully requested. The Examiner is invited to telephone the undersigned in the event that a telephone interview will advance prosecution of this application.

Respectfully submitted,

Niels Haun
PTO Reg. No. 48,488

DANN DORFMAN HERRELL & SKILLMAN
A Professional Corporation
1601 Market Street, Suite 720
Philadelphia, PA 19103
Phone: (215) 563-4100
Fax: (215) 563-4044

ATTACHMENT

The following are the marked up copies of the specification as amended. Bracketed text has been deleted, and underlined text has been inserted.

1. Copy of the paragraph beginning at page 3, line 14 marked up to show amendments.

According to an exemplary embodiment of the present invention, an optical switch includes a first wave[d]guide holding member and a second waveguide holding member disposed on a substrate. The first waveguide holding member moves relative to the second waveguide holding member. A movement guiding member guides the motion of the first waveguide holding member.

2. Copy of the three consecutive paragraphs beginning at page 8, line 8 marked up to show amendments.

Turning to Fig. 2, [a perspective] <u>an exploded</u> view of an optical switch 200 according to an exemplary embodiment of the present invention is shown. A substrate 201 illustratively includes longitudinal grooves 203 and transverse grooves <u>202</u> [204]. The longitudinal grooves 203 and transverse grooves <u>202</u> [204] are adapted to receive positioning members <u>204</u> [205]. The positioning members <u>204</u> [205] are illustratively microspheres or other suitable sphere-shaped objects. The positioning members <u>204</u> [205] are disposed between the longitudinal grooves 203 and pits 207 disposed in second waveguide holding member 206. Positioning members <u>204</u> [205] are also positioned between transverse grooves <u>202</u> [204] and pits 208 disposed in first waveguide holding member 205. As can be readily appreciate<u>d</u> the longitudinal and transverse grooves 201 and 202 of the substrate and the 208, 207 pits on the first and second waveguide holding members 205 and 206, respectively are on opposing surfaces thereof.

Illustratively, transverse motion of the first waveguide holding member 205 is achieved by motion of the positioning members <u>204</u> [205] in grooves <u>202</u> [204]. The positioning members <u>204</u> [205] are constrained by pits 208. Likewise, longitudinal motion of second waveguide holding member 206 is achieved through the motion of positioning members <u>204</u> [205] in longitudinal grooves 203. The positioning members <u>204</u> [205] are constrained in pits 207 in the second waveguide holding member 206.

As described in more detail above, the longitudinal motion may be used to adjust gap spacing 209 between the first waveguide holding member 205 and the second waveguide holding member 206. Transverse motion of the first waveguide holding member 205 may be used to achieve switching between waveguides 210 and 211. To this end, switching is achieved by selectively coupling/decoupling waveguides 210 disposed in first waveguide holding member 205 with waveguides 211 [210] disposed in second waveguide holding member 206. Finally, it is of interest to note that waveguides 210 and 211 may be disposed on the lower surfaces of the first and second waveguide holding members 205 and 206, respectively. They may be held in v-grooves (not shown), for example. Moreover, the waveguides 210 and 211 may be disposed on the top surfaces of the waveguide holding members 205 and 206, respectively. Finally, waveguides 210 and 211 may be disposed within waveguide holding members 205 and 206, thereby being integral [integer] parts thereof.

3. Copy of the three consecutive paragraphs beginning at page 10, line 1 marked up to show amendments.

Positioning members 307 are disposed between longitudinal grooves 303 in substrate 301 and grooves 308 disposed in second waveguide holding member 309. Positioning members 307 are illustratively cylindrical-shaped rod elements which enable the longitudinal motion (x-direction) of first waveguide holding member 306. Illustratively, positioning members 307 may be sections of optical fiber or micromachined rods. Moreover, positioning members may be glass, metal or ceramic. Similar to the illustrative embodiment of FIGS. 1 and 2 the longitudinal motion of second waveguide holding member 309 enables the adjustment of the gap spacing 310 between the first waveguide holding member 306 and the second waveguide holding [holder] member 309 to enable coupling of optical fibers 311 and 312.

In the illustrative embodiments of FIGS. 2 and 3, the grooves 202, 203, 302, 303 and 308 are illustratively v-shaped grooves. The pits 207, 208 and 305 are illustratively inverted pyramidal-shaped pits. The grooves and pits are formed by illustrative techniques described below. Finally, in the illustrative embodiments of FIGS. 2 and 3, first waveguide holding members 205 and 306 and second waveguide holding [holder] member 206 each include four pits which constrain positioning members 204 and 304. As can be readily appreciated, at least

three pits are required for stability and motion constrain. Other numbers of pits and positioning members may be used in keeping with the present invention. Finally, grooves 202, 203, 302, 303 and 308 and pits 207, 208 and 305 may be lined with a suitable material to reduce wear and/or friction.

The inverted pyramidal pits and grooves may be formed by anisotropic wet etching of a monocrystalline material. Illustratively, monocrystalline material may be selectively etched according to known techniques. The surfaces of the inverted pyramidal pits are along well-defined principle planes of the monocrystalline material. One such known technique for anisotropic etching of monocrystalline material may be found in U.S. Pat. No. 4,210,923 to North, et al., the disclosure of which is specifically incorporated by reference herein. Of course, other known etching techniques may (wet or dry) be used to form the pits and grooves. Moreover, other materials may be used for the substrate and first and second waveguide holding members. These include, but are not limited to, glass, quartz, metal or plastic. The grooves and pits may be formed therein by known techniques.

4. Copy of the paragraph beginning at page 11, line 17 marked up to show amendments.

Fig. 4 shows an optical switch 400 according to an illustrative embodiment of the present invention. A substrate 401 has transverse v-grooves 402 disposed therein. The substrate 401 further includes longitudinal v-grooves 403. A first waveguide holding member 404 includes first waveguides 405. The waveguides 405 may be disposed on top of the first waveguide holding member 404; on the bottom of first waveguide holding member 404 [405]; or within the first waveguide holding member 404. A second waveguide holding member 406 includes second waveguides 407. The second waveguides 407 may be disposed on a top surface of second waveguide holding member 406; a bottom surface of second waveguide holding member 406; or within the second waveguide holding member 406. Waveguides 405 and 407 are illustratively optical fibers. However, waveguides 405 and 407 may be planar waveguides. In the illustrative embodiment of Fig. 4, first positioning members 408 are disposed in pits 409 in the first waveguide holding member 404. Likewise, second positioning members 410 are disposed in pits 411 in the second waveguide holding member 406.

5. Copy of the two consecutive paragraphs beginning at page 13, line 1 marked up to show amendments.

Illustratively, a movement guiding member may comprise a second positioning member 410 disposed between a pit 411 and a transverse groove <u>402</u> [413]. The transverse motion of waveguides 407 relative to waveguides 405 enables the selective coupling/decoupling of waveguides. This facilitates the switching of a signal from one waveguide to another. For example, an optical signal may be traversing waveguide 413 of the first waveguide holding member 404. This waveguide may be coupled to waveguide 414 disposed in second waveguide holding member 406. As can be readily appreciated, movement of the second waveguide holding member 406 in either the +y-direction or the -y-direction may uncouple waveguide 413 from waveguide 414. Movement in the +y-direction, for example of a predetermined distance may enable coupling of the optical signal traversing waveguide 413 into waveguide 415. As such, coupling of the optical signal is "switched" from waveguide 414 to waveguide 415.

In the exemplary embodiment, waveguides 405 and 407 each comprise a row of three waveguides. Of course, this is for purposes of illustration, and more or fewer waveguides may be used. Moreover, as can be readily appreciated, waveguides 405 of the first waveguide holding member 404 may be a linear array (a row) or a matrix of a suitable number of rows and columns of optical waveguides. Likewise, optical waveguides 407 of the second waveguide holding member 406 may also be a linear array (a row) or a matrix having a suitable number of rows and columns. Moreover, the pitch between waveguide<u>s</u> 405 may be the same or different than that of waveguides 407. As such, sophisticated switching schemes may be realized through the transverse motion of the second waveguide holding member 406 relative to the first waveguide holding member 404.

6. Copy of the two consecutive paragraphs beginning at page 14, line 8 marked up to show amendments.

The motion of the positioning members <u>504</u> [505] in the transverse grooves 502 enables the transverse motion (y-direction) of the second waveguide holding member 506 relative to the first waveguide holding member 507. The transverse motion enables the selective coupling/decoupling of optical waveguides 508, 509 and 510 to waveguides 511,

512 and 513, respectively. Transverse motion of the second waveguide holding member 506 would change this coupling, enabling a switching action.

In the illustrative embodiment of Fig. 5, positioning members 514 are disposed in pits 515 in the second waveguide holding member 507. As can be readily appreciated, the engagement of the positioning members 514 within the longitudinal grooves 503 in the substrate 501 enables longitudinal movement (x-direction) of the second waveguide holding member 507. According to the illustrative embodiment of Fig. 5, the second waveguide holding member 507 may have an endface 516 which is polished. The gap spacing 517 may be accurately determined by elements 518 which are illustratively ball lenses or <u>microspheres</u> [microshperes] disposed in grooves 519 the first waveguide holding member 506. The gap spacing 517 is illustratively in the range of approximately less than 1 μm to approximately 15 μm.

7. Copy of the paragraph beginning at page 16, line 14 marked up to show amendments.

As described in connection with the illustrative embodiments above, waveguides 708 and 709 are selectively coupled/decoupled with the transverse motion of the first waveguide holding member 703 relative to the second waveguide holding member 706. Moreover, the longitudinal motion of the second waveguide holding member 706 enables accurate gap spacing between the first waveguide holding member 703 and the second waveguide holding member 706, thereby enabling efficient coupling between the waveguides 708 and 709. After the gap spacing is adjusted, a suitable adhesive known to one of ordinary skill in the art may be used to fix the position of the <u>second</u> [first] waveguide holding member <u>706</u> and thereby set the gap spacing at the determined position.

The following are the marked up copies of the claims as amended. Bracketed text has been deleted, and underlined text has been inserted.

1. (Amended Once) An optical switch, comprising:

A first waveguide holding member and a second waveguide holding member disposed over a substrate, wherein said first waveguide holding member moves relative to said second waveguide holding member; and

at least one movement guiding member which guides the motion of said first waveguide holding member relative to said substrate so that said first waveguide holding member moves transversely relative to said second waveguide holding member.

6. (Amended Once) An optical device as recited in claim [5]1, wherein said transverse movement of said first waveguide holding member selectively couples at least one waveguide of said first waveguide holding member to at least one waveguide of said second waveguide holding member.

10. (Amended Once) An optical switch as recited in claim 7, wherein said pit [groove] is disposed in said substrate and said groove [pit] is disposed in said first waveguide holding member.

14. (Amended Once) An optical switch as recited in claim 12 [11], wherein said pit is disposed in said second waveguide holding member, and said groove is disposed in said substrate.

15. (Amended Once) An optical switch as recited in claim 12 [11], wherein said groove [pit] is disposed in said second waveguide holding member, and said pit [groove] is disposed in said substrate.

27. (Amended Once) An optical switch as recited in claim 24, wherein said second waveguide holding member moves transversely along said at least two transverse grooves and said transverse movement selectively decouples at least one waveguide of said first

waveguide holding member <u>from</u> [to] at least one waveguide of said second waveguide holding member.

30. (Amended Once) An optical switch as recited in claim 28, wherein positioning members are disposed between each of said at least one transverse grooves in said substrate and each of said at least one <u>transverse</u> [longitudinal] groove in said first waveguide holding member.

34. (Amended Once) An optical switch, comprising:

At least <u>two</u> [one] waveguide holding member<u>s</u> disposed on a substrate;

at least two <u>holding member</u> depressions disposed in each of said at least <u>two</u> [one] waveguide holding members; and

at least two <u>substrate</u> depressions disposed in said substrate,

wherein at least three of said <u>substrate and holding member</u> depressions are grooves<u>,</u> and <u>wherein at least one of said substrate and holding member depressions is configured to permit transverse movement of said waveguide holding members relative to one another to effect optical switching</u> [no two opposing depressions are pits].